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Challenges of a professional master's student in Mathematics Education: what my experience allows me to say

Abstract: Since its creation, the professional master's degree has allowed master's students to reflect on pedagogical practice in Mathematics. In this context, this article aims to analyze the challenges of a master's student of a professional program in composing her field intervention and the resonances of this for her professionalism. To this end, the methodology is supported by a narrative perspective, in which the significant points of the master's field process are described. As a result, it can be seen that the moment of planning and the moment of application are fundamental and striking in the constitution of professionalism in a context of professional master's, allowing significant spaces for reflection and production of the identity of a researcher in his own practice. With the study, the need for professional master's degrees to trigger discussions on the training of student-teachers who attend their courses is concluded.

Keywords: Professional Master's. Experience. Challenges.

Desafíos de un estudiante de maestría profesional en Educación Matemática: lo que mi experiencia me permite decir

Resumen: Desde su creación, la maestría profesional ha permitido a los estudiantes de maestría reflexionar sobre la práctica pedagógica en Matemáticas. En ese contexto, este artículo tiene como objetivo analizar los desafíos de una estudiante de maestría de un programa profesional en la composición de su intervención de campo y las resonancias de esto para su profesionalismo. Para ello, la metodología se apoya en una perspectiva narrativa, en la que se describen los puntos significativos del proceso de campo de la maestría. Como resultado, se puede apreciar que el momento de la planificación y el momento de la aplicación son fundamentales y llamativos en la constitución del profesionalismo en un contexto de maestría profesional, permitiendo espacios significativos de reflexión y producción de la identidad de un investigador en su propia práctica. Con el estudio, se concluye la necesidad de que las maestrías profesionales desencadenen discusiones sobre la formación de los estudiantes-docentes que frecuentan sus cursos.

Palabras clave: Máster Profesional. Experiencia. Desafíos.

Desafios de uma estudante de mestrado profissional em Educação Matemática: o que minha experiência permite dizer

Resumo: Desde sua criação, o mestrado profissional permite a reflexão de mestrandos sobre a prática pedagógica em Matemática. Nesse contexto, este artigo ensina analisar os desafios de uma mestranda de um programa profissional em compor a sua intervenção de campo e as ressonâncias desta para a sua profissionalidade. Para tanto, a metodologia apoia-se numa perspectiva narrativa, em que se descreve os pontos significativos do processo de campo do mestrado. Como resultado, percebe-se que o momento de planejamento e o momento de aplicação são fundamentais e marcantes na constituição da profissionalidade em um contexto de mestrado profissional, possibilitando espaços

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significativos de reflexão e produção da identidade de pesquisador da própria prática. Com o estudo, conclui-se a necessidade de os mestrados profissionais desencadearem discussões sobre a formação dos estudantes-professores que frequentam seus cursos.

Palavras-chave: Mestrado Profissional. Experiência. Desafios.

1 Introduction

Becoming a teacher and researcher is not a linear and/or predetermined cause-effect process. For us¹, this formation results from the subject's choices and a composition of chance. It is a meeting between the teacher and what is different, what is *foreign* (LARROSA, 2011).

To discuss the topic of becoming a teacher and a researcher, the most viable choice we found is to narrate the process since it is in the specifications of the procedures that significant points of education stand out.

In this sense, this study aims to analyze the challenges a master's student faced in a professional program when composing her field intervention and how they echoed in her professionalism. To consolidate this objective, we list the following sections of the article: *Theoretical reference*, discussing the idea of teacher education; *Methodological aspects*, in which we point out the analysis perspective of the article; *Constituted thesis*, describing the thesis that gave rise to the reflections; and *Data analysis*, presenting the produced reflections.

2 Theoretical background

Based on studies of the epistemology of practice (SCHÖN, 1992), in the field of teacher education, the understanding that the teacher's identity is made up of knowledge is promoted. This perspective highlights that a possible transformation in teaching can occur from the reflection of the subjects' professional practice and the knowledge produced in the school routine.

When thinking of practice as the construction of knowledge, Tardif (2000) emphasizes that this knowledge is plural and multidimensional, which allows conceiving it as composed of different types of knowledge from different sources and contexts. In this sense, interventionist practices in a professional master's degree are configured as one of these contexts and sources, capable of enhancing teacher education.

¹ The authors of this article.

In this sense, Pimenta (1999) points out that the constitution of this identity is characterized by the mutability and historicity of teaching production. In other words, teaching constitutes an element that changes according to the demands, history, and encounters experienced by the teacher.

Such encounters are capable of generating experiences and affection. As Larrosa (2011) points out, experience is considered *what happens to us*. In other words, the encounters that are capable of producing resonances and destabilizing the teacher, enhancing the creation and/or reframing of new teaching knowledge. As an educational set of ideas, perhaps this is the intention of professional master's programs.

Similarly, according to Roldão (2008), it is through these formative and reflective practices that teaching professionalism is constituted. That is, the “progressive process of professional construction that follows throughout the teacher's life” (ROLDÃO, 2008, p. 42). From this perspective, the professional master's course can enhance the creation of strategies and mechanisms for the continuity of teacher education.

3 Methodological Aspects

This discussion is guided by a qualitative approach (BOGDAN and BIKLEN, 1994). It concerns the subjectivities and understandings of what the first author experienced during her professional master's degree in education. Thus, the research subject and the researcher intertwine in this article: they are both found in the study's writings.

The subject-researcher-author of this paper has a pedagogy degree qualification, and a master's degree in education, both certificates obtained at a federal institution in Rio Grande do Sul. In both courses, she studied teacher education and mathematics teaching for children, which fostered her formative desire for the mathematics education area. She also teaches in several groups with children from the early years of elementary school in the region where she lives.

For data production, the study used a narrative policy of knowledge, in which we visualize the consolidation of the poetics of knowledge, aiming to

[...] break with the hierarchical separation between the discourse that explains and what must be explained by it; the separation between the intellectual (who would be aware of the rationality of power and domination) and the ordinary man (the madman, the prisoner, the worker, in short, the individual who would not be aware of his/her domination) (MARQUES and PRADO, 2018, p. 9).

In this sense, according to Torril (2008), narrative investigation consists in “the study of how human beings experience the world, and narrative researchers collect these stories and write narratives of experiences” (p. 292). Thus, the narration of the research is the result of the crossings experienced by the teacher-researcher during her intervention in the professional master’s degree.

In this way, the narrative of the data analysis is made up of two moments: (i) a descriptive moment about the thesis, aiming that readers know and understand the research carried out during the professional master’s degree; and (ii) the analysis of the master’s intervention, emphasizing the act of planning and intervention actions as dimensions that shape the researcher’s professionalism.

4 The thesis constituted

The thesis was an action research, first problematized by the experiences of the first author in her supervised teaching practice in the pedagogy course and her end-of-course paper, a study focused on a 1st-grade elementary school class on the outskirts of a city in the countryside of Rio Grande do Sul.

According to Thiollent (1986), action research is based on empirical questions whose structure is associated with an action directed towards understanding and/or solving a problem of a more collective nature.

For Engel (2000, p. 184), “the research process must become a learning process for all participants, and the separation between subject and research object must be overcome”. That is, the subjects start to participate in the research process no longer just as contributors and become part of the action research in collaboration with the planning of actions that help in the search for the resolution of the research problem.

In this context, based on an exploratory phase with interviews with the teacher and observation in the 1st grade of elementary school, we decided on the following research objective: To analyze the contributions of unstructured concrete resources for teaching numbers in a 1st-grade class of an elementary school, upstate Rio Grande do Sul.

For further development, we carried out a theorization phase focused on the central theoretical elements of the research: the formation of the concept of numbers, the use of unstructured materials for teaching mathematics, and a review of literature on the

topic.

In the third moment, we prepared the planning and intervention phase, in which the didactic sequence of work is described and developed (Chart 1).

Chart1: Activity list

Activity	Description	Resource
Social uses of the numbers	- Discussion about social uses of the numbers; - Cut the packaging barcodes and draw the products.	Packaging
Comparison and grouping of quantities	- A dice will be thrown, and the students must use the number that comes out to make groups with the popsicle sticks.	Popsicle sticks
Comparison and grouping of sets	- Comparative discussion between two groups of bottle caps: larger, smaller, and equal.	Bottle caps
Count quantities to a hundred	- Fictitious reproduction of buying and selling practices carried out in a market.	Fancy banknotes

Source: Research Data

Faced with field incursions and the difficulties and potentialities of intervention analysis, some significant points of the author-researcher's education were raised and listed in the following analyses.

5 The analyses undertaken

Based on the research intentions, we elaborated a (self) assesment process of the intervention that emerges from the meeting of the researcher's understandings of the research field. To this end, the researcher reread the logbook and resumed significant memories of her pedagogical practice related to two moments: a) intervention planning and b) activities developed.

5.1 Intervention planning

It was difficult for me² to construct the activity planning because I did not know much about the class, their knowledge or their needs. Despite my observing them at several moments, I believe I could try other elements, for example, a diagnostic assessment.

When referring to the subject, Haydt (2000), for example, emphasizes that,

at the beginning of each teaching unit, it is recommended that the teacher

² As this moment of the research is of self-assessment and an attempt to reframe my practice as a teacher and researcher, my impressions are written in the first person singular.

checks what information their students already have on the subject and whether they have the necessary skills to master the content, which facilitates the development of the unit and helps to ensure the effectiveness of the teaching-learning process (p. 20).

In this sense, an initial strategy that would bring a diagnosis about the concept of numbers would produce interesting elements for the intervention.

We emphasize that the assessment should not be a test about numbers but an action that represents our pedagogical conception of action, as Luckesi (2002) highlights.

Thus, I prepared the plan without delving into the students' prior knowledge of numbers. Some initial strategies for this could be using games, conversation circles, or activities that problematize the concept.

However, because we were in a pandemic moment, the school asked me to optimize my time with the group. Many of the possibilities thought of at the beginning of the research were reduced. In this sense, the intervention prioritized a new ethics of researching, which limited many activities out of respect for life and health.

On the other hand, it was rewarding to propose activities that showed elements of the community's social practice when planning the intervention. I remind you here that I have known the school and its community since my graduation, as I pointed out in the introduction to the research. Thus, I believe that having a space for debating the concept of numbers and discussing elements of the students' life context allowed my pedagogical work to link to "a historical and social context that gives structure and meaning to what is done" (WENGER, 1998, p. 47).

Another relevant point for me to become a teacher and researcher was to plan classroom practices that turn away from what I experienced in the early years of elementary school. Like other pedagogy professionals (MORAES, 2018), my life story with mathematics is filled with anecdotes of cruel mathematics teachers, repetitive exercises, and rote learning. In this context, I looked for an action that would come with a reflective and problematizing possibility on the concept of numbers for children; something beyond the "little beads".

As for planning with unstructured concrete resources for teaching numbers, the pandemic moment made developing activities more difficult. Everything we touched during the intervention needed to be sterilized before and after use. In addition, there were times when I needed to stop the intervention to ask the students not to share the objects.

In a way, I realized that this practice inhibited debates in pairs or groups and stimulated individualization in the class.

Even with this difficulty, when planning, I felt that it contemplated aspects of the students' reality since the activities were designed with objects that were part of their life context. That is, as Reys (1971) points out, concrete resources make it possible to link concepts with the contexts experienced by children.

5.2 Activities carried out

The activities were prepared based on the skills listed in the National Common Curricular Base (BNCC) for the 1st grade of elementary school on the concept of numbers. This idea was pertinent to the development of the research because the intention of a curricular proposal is to generate its implementation and impact on teaching practices and student learning (SACRISTÁN, 2013).

However, one of the actions that could be carried out to expand the performance of the intervention on the concept of numbers would be the constitution of the concept in a network of meanings. According to Machado (2008), a concept is formed from multiple relationships, applications, meanings, ideas, social uses, etc. That is, in the field of our research, the concept of numbers is made in their multiplicity.

In my theorizing and planning process, I looked for some of these relationships, but it would be interesting to create a whole. Perhaps a map of the concept of numbers so as not to lose sight of the conceptual totality in daily activities and interactions with the children's group. Thus, we would not miss opportunities for debate in the classroom about the relations of the concept of numbers, even if they did not belong to the lesson at stake.

I still consider it relevant to problematize the possibility that the activities were constituted by the same theme. I noticed that, during the process, the children associated actions carried out on one day with the next, which helped me realize the continuity of the action. However, a powerful idea for pedagogical practice in mathematics in the early years would be the processes of *teaching scripting* (MORAES, 2018). In other words, from a theme, to create sequences to produce teaching mechanisms. According to Moraes (2018), this idea allows for the production of a thread-situation that leads to teaching action and that problematizes the object of study. I give two examples that could contribute to this idea: project pedagogy (HERNÁNDEZ, 1998) and didactic sequences (DOLZ, NOVERRAZ and SCHNEUWLY, 2004).

As for the first activity, I intended to lead students to debate the functions of numbers (order, counting, and code) and their uses in our daily lives. Among the positive points of this activity, I point out the participation of the class. I believe that the children's age (6 and 7 years old), my initial speech asking for the group's support, and an intervention based on questions made the group engage in the activity.

On the other hand, I found it quite surprising that the students' answers about "places where we find numbers" were restricted to the classroom environment. I hoped the students would give other examples, such as weight, height, toys, personal documents, and signs; however, it did not happen immediately.

In this way, I learned that the pedagogical intervention would need to add some unexpected questions or change the path during the conversations with the class. As Nóvoa (2006) points out, as a beginner, the classroom as a field of research and teaching is challenging.

I believe that dealing with the unexpected is one of the needs for both the researcher and the beginning teacher. In this context, the support of others became fundamental. For example, my advisor fostered many retakes of this research. Likewise, the class teacher fostered many retakes for the intervention with the students. Perhaps this support echoes Nóvoa's (2006) comment:

[...] if we cannot build more harmonious, more coherent forms of integration with these teachers, we will accentuate, in these first years of the profession, dynamics of individual survival that necessarily lead to their individualistic closure (p. 14).

During the first activity, I also began to realize the need to respect the students' learning time. I believe that I managed to introduce the group to numbers not only as a counting instrument but also as codes. However, I think the time I offered for this debate was short due to the doubts raised by the group. In this sense, I perceived the need to improve this element in my research and teaching processes. Or, as Albuquerque (2010) says, knowing how to deal with students' learning time is a characteristic of an effective teacher.

When looking back on this activity and if I could suggest a significant element in this context, I would say that my planning would come with "cards up my sleeve". Perhaps having other activities available to work on the theme or even moments of conversation circles to summarize the debate. I missed, for example, a more in-depth

discussion about numbers as codes in personal documents.

In the second activity, I asked the students to count sticks with the same number of letters as their names. Again, I intended to focus on counting and comparing, and establishing relationships with the notions of “more than” and “less than”.

Between the positive points of this moment, I point out the group’s interest and participation in the activity. I believe that one of the elements of the situation that made them remarkable was the link of the activity with the students’ names. According to the Referencial Curricular Nacional para a Educação Infantil [National Curriculum Reference for Early Childhood Education], identity “is a concept that includes the idea of distinction, of a mark of difference between people, starting with the name, followed by all the physical characteristics, the way of acting and thinking, and personal history” (BRASIL, 1998, p. 13). In this way, I consider that what is related to us can promote the interest of the group of subjects in the research field.

As negative points, I emphasize the difficulty in controlling the group’s excitement, the excess of speeches, and the exacerbated time of my exposition, which took up much space in the pedagogical action. In this sense, I would add more spaces for children’s registers on paper to the search. According to Powell and Bairral (2006),

for some years now, mathematics educators have been exploring the link between writing and mathematics, particularly writing as a support for learning. Objectives and ways of implementing writing in teaching have been varied. From this variety, two approaches can be distinguished: product and process-product. While in the first approach writing is used as a resource to declare knowledge, in the second, it is considered a means of knowledge. In the first, educators involve students in written activities more focused on mathematics, and, in the second, on the students themselves. We must avoid this polarization. Individuals must have opportunities to analyze their thinking, constructed meanings, and forms of mathematical reasoning present. The individual development and mathematical thinking through writing is what we should aim at (p. 50-51).

In this sense, I believe that more moments of writing would increase my intervention practice, even if these were not formal, but that allowed children to reflect on their own thoughts about numbers.

As for the unstructured concrete resource, the second activity involved using popsicle sticks and the money band. I realized this was the most powerful resource for building the group’s learning. My understanding starts from the understanding of Santos, Oliveira, and Oliveira (2013) when they emphasize that the role of the concrete resource

is to develop the student's reasoning and produce conceptual schemes and meanings.

Making groups of sticks (tied together) allowed a process of constant manipulation of objects, transforming units into groups. In this way, I envisioned that cognitive processes of the concept of numbers — counting, grouping, and addition, among others — occurred in association with the manual processes of using the resource.

Furthermore, I point out two questions about the use of this resource. The first is that the greatest success in carrying out this activity occurred with students with more difficulties. I think that this fact is associated with the findings in the research of Selva and Brandão (1998). They emphasize that the resource allows the students to have support in constructing their mathematical thinking, relating the concrete and the abstract.

In turn, the second issue is that students who found it easier to grasp the concept of numbers found it hard to use concrete resources in their performance. Many students were used to supporting counting and grouping on mental calculations, which made the sticks become objects that interfered with their work processes with the concept of numbers.

In the third activity, I expected the students to be able to count and group the sticks sequentially. I believe that I achieved the expected objectives for this moment because all students could count correctly and perform the requested sums.

In this activity, I listed as an important strategy for working with the concept of numbers with the students the relationship between the individual and the collective. Thus, sometimes, the group debated about how the intervention process was being held until then, and, at other moments, I had individual conversations with the students.

The collective approach optimized my time with the class, but at the same time, it hid inferences and speeches from shyer students. The individual approach, carried out desk by desk, was significant for the students; with it, I could understand their understanding more deeply. However, an individual look demanded more time and dedication and greater control of the children.

It is noteworthy that on this day of work, I was afraid to use the number line, presented as a possible support element for numerical ability, according to the BNCC (BRASIL, 2017).

For Ventura (2006), the use of the number line in the teaching of mathematics:

- 1st: It enables a higher level of mental activation, providing learning support.
- 2nd: It is a more natural and transparent model for operations with numbers.
- 3rd: It is an open model for informal strategies and also provides support for the child to develop more formal and efficient strategies;
- 4th: It is a model that improves the flexibility of mental strategies (VENTURA, 2006, p. 53).

In the research context, I thought the resource could take the focus away from the unstructured research resources. However, I emphasize that perhaps the number line could subsidize a pedagogical practice in which we encourage the child to place objects, events, and actions in all possible relationships (KAMII, 1990).

Agreeing with Kamii (1990) regarding the unstructured concrete resource in this activity (popsicle sticks and cups), I think my performance focused too much on issues involving collective responses. I could have given more space for the students to explore the resource, build their groupings as they saw fit, develop hypotheses, and discuss them with classmates. I inferred that immediate teacher/researcher interference is not always viable and potent for students' construction of ideas.

In the last activity, I explored the use of the grocery store as a strategy for teaching number concepts. I believe that because it is an activity that copies a reality practice, this was the activity with the more participation and inferences from the group. Thus, I think this moment has reached Lorenzato's (2012) assumptions from a perspective that moves away from the traditional,

[...] giving rise to the development of the apprentices' intelligence and the consequent formation of people who know how to discern, choose, and decide. This perspective manages to broaden students' views and questions, not only retaining the classroom context, making them autonomous, critical, and reflective beings (LORENZATO, 2012, p. 58).

I also believe that the minimarket proposal promoted a playful attitude towards numbers. Again, this is part of an imaginative and creative look at the child's social context, using this for the learning process and development of mathematical concepts in the first year of elementary school.

As for the non-structured concrete resource used in this activity, the fancy banknotes, I noticed that, although we can consider this a powerful mathematical element in children's daily lives, its use in the school environment requires a planning practice like any other resource.

The power of this resource was that the students relived real situations of

mathematical use with banknotes to the point of imitating moments experienced in everyday life. This fact makes it possible to consider banknotes as a good resource for mathematics teaching since “they can be used to model a large number of mathematical ideas” (LORENZATO, 2011, p. 87)

Finally, in addition to the points above, during the intervention, another striking point was that I have always tried to cultivate an attitude: “I’m going to listen more than be heard” I believe that this is a necessary modest attitude. I do not have the teacher’s experience in teaching mathematics with 1st-grade children. Even if I had this experience, I was in a condition I had never experienced, that of a researcher. So, I needed calm and much support from the teacher and the class.

6 Final considerations

This article aimed to analyze the challenges of a master’s student in a professional program in composing her field intervention and how it echoed in her professionalism. To achieve that objective, she used a narrative analysis of the interventionist practice during her master’s research. The narrative made it possible to give visibility and power to the events of becoming a teacher. Thus, who we are is the result of multiple experiences, doubts, and constructions of our relationship with each other and with the challenges of everyday life.

From the analysis, we noted two remarkable moments for the formative constitution of authorship: planning and application. As for planning, there is a need for more in-depth diagnostic practices that guide intervention actions. Regarding the application, the groups’ participation and the space for reflection are fundamental for the success of the research.

However, this research resonates with some limits. First, this is the story of a master’s student. Some things can be lived and experienced by others, but we cannot generalize and consider that everyone experiences the same anxieties and challenges. The second point is that the look at the object is loaded with subjectivities and tensions typical of a beginner in research. Maybe the more experienced teachers will face other challenges.

Finally, we consider that this article can contribute to minimizing the anxiety and anguish of master’s students who wish to carry out their field research. It can also allow enhancing practices in professional master’s programs interested in continuous and

reflective teacher education.

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